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Evaluation of 1996 NRC for Protein and Phosphorus Requirements of Finishing Cattle

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The 1996 NRC computer model does not under-predict the protein and phosphorus requirement of finishing calves and yearlings

Summary

Two trials were conducted to evaluate the 1996 Beef NRC computer model for protein and phosphorus requirements of feedlot cattle. The control ration was formulated for the same levels of crude protein (13.5%) and phosphorus (0.35%) in both trials; however, supplemental protein was from urea in Trial 1 and urea, feather meal and blood meal in Trial 2. The balanced ration was formulated utilizing the 1996 NRC. The balanced ration was changed to effectively meet the changing requirements for DIP, UIP and P. In Trial 1, gains and efficiencies were similar between treatments; however, DMI was lower with cattle fed the balanced ration. In Trial 2, animal performance was unaffected by dietary treatment. These results indicate that the 1996 NRC model does not under-predict finishing steer protein and P requirements.

Introduction

In 1996, the NRC beef committee updated the requirements for beef cattle. There were numerous advancements adopted, including a computer model and a metabolizable protein (MP) system. The MP system accounts for two different requirements, microbial and animal, which must be met to optimize performance. Each feedstuff is degraded to various degrees in the rumen. For

example, high-moisture corn (HMC) is 8 - 10% protein which is 60 % degradable in the rumen, whereas dry-rolled corn (DRC) contains the same amount of crude protein but is only 40 % degradable by the ruminal microbes.

Calves have a higher MP requirement than yearlings. At the same time, calves require less MP at the end of the finishing period than at the beginning. Therefore, if the diet is to meet the requirements, the diet must change both between yearlings and calves and within time on feed. This is commonly referred to as "phase feeding." Understanding this system allows nutritionists to more effectively optimize performance without overfeeding.

Protein requirement can be divided into two segments, degradable intake protein (DIP), which meets the microbial requirement and undegradable intake protein (UIP), which bypasses the rumen and is used by the animal at the small intestine in addition to microbial protein leaving the rumen. Our objective was to evaluate the 1996 NRC guidelines with both calves and yearlings and balance a ration to meet the DIP and UIP requirements while minimizing the overfeeding of protein and phosphorus.

Procedure

In Trial 1, 96 crossbred, yearling steers (BW = 656 lb, age = 14 mos) were randomly assigned (8 hd/pen) to either the control ration or the balanced ration. Steers were on feed 147 days from May 10 to October 4, 1996 and implanted with Revalor-S on day 0 and day 84. Cattle were adapted to the finisher diet with four step diets containing 45, 35, 25 and 15 % alfalfa hay fed for 3, 4, 7 and 7 days respectively. The control ration (Table 1) was formulated to provide 13.5 % crude protein and 0.35 % phosphorus (P), with all supple-

mental protein from urea. The balanced ration was formulated using the 1996 NRC model (predicted final wt = 1200, 50 % Br X 50 % Cont, ADG = 3.7 lbs/d) to meet and not exceed the DIP requirement and minimize excess UIP in the diet. Since protein from HMC is more degradable in the rumen, and the requirement for DIP as a portion of MP required is greater for yearlings, the DRC was replaced with HMC in the balanced ration to minimize overfeeding of UIP. Likewise since corn contains 0.25 to 0.30% P, and the requirement is 0.23 % P for 750 lb yearlings, the balanced ration contained enough corn bran (0.10 % P) to meet, but not exceed, the P requirement predicted by the NRC model. Since the P requirement changes with days on feed, various levels of corn bran were fed for 28, 28 and 58 days, respectively.

In Trial 2, 96 crossbred steer calves (BW = 541 lb, age = 8 mos) were randomly assigned (8 hd/pen) and fed for 193 days from November 8, 1996 to May 20, 1997. Steers were implanted on day 1 and day 97 with Revalor-S. Cattle were adapted to finisher diets (7.5 % alfalfa) similar to Trial 1 except each step ration was fed for 7 days. The control ration was formulated to provide 0.35 % P and 13.5 % crude protein just as Trial 1; however, supplemental protein was from urea, 1.4 % feather meal and 0.2 % blood meal on a DM-basis, supplemented for escape protein throughout the 193 days. The balanced ration was formulated similarly to Trial 1 (predicted final wt = 1200 lbs, 50 % Br X 50 % Cont, ADG = 3.9 lbs/d). Table 1, however, illustrates the change in requirement with calves as predicted by the NRC. The first seven finisher diets were fed for 14 days each and finisher 8 was fed until slaughter. Since calves initially require less DIP as a percentage of total protein fed, DRC was used and gradually switched over to HMC by

Table 1. Diet composition (% of DM).

Item ^a	Trial I — Yearlings				Trial II — Calves								
	Contr.	Fin 1	Fin 2	Fin 3	Contr.	Fin 1	Fin 2	Fin 3	Fin 4	Fin 5	Fin 6	Fin 7	Fin 8
DRC	81.3				82.5	82.5	82.5	82.5	82.5	59.5	35.0	4.5	
HMC		67.4	64.6	61.4						16.5	36.5	61.0	57.5
C.bran		17.2	19.9	23.1						6.5	11.0	17.0	25.0
Liq-32 molasses	6.2				5.0								
fat		3.0	3.0	3.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Alfalfa	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Suppl.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
urea	0.52	0.76	0.76	0.76	0.29	0.83	0.88	0.91	0.96	0.87	0.75	0.62	0.60
FM ^b					1.40	1.60	1.15	0.75	0.18				
BM ^c					0.20	0.20	0.14	0.10	0.02				
dical P	0.48				0.47	0.10	0.04						
CP (%)	13.6	11.2	11.9	11.5	13.4	12.7	12.4	12.1	11.7	11.5	11.2	10.8	10.9
UIP (%) ^d	4.48	3.67	3.67	3.67	5.16	5.51	5.23	4.99	4.64	4.11	3.68	3.11	3.02
P (%)	0.34	0.24	0.24	0.22	0.35	0.26	0.25	0.24	0.24	0.23	0.22	0.21	0.20

^aDry-rolled corn, high-moisture corn, corn bran and liquid supplement

^bFeather meal.

^cBlood meal.

^dBalanced finishers for Trial 1 unavoidably contained more UIP than required.

finisher 7. The P requirement also decreases with increasing weight of the animal, so HMC was gradually replaced with corn bran to prevent overfeeding of P.

Initial weights used for both trials were an average of two consecutive weights at the initiation of the trial following a 5-day limit-feeding period. At slaughter, hot carcass weights and liver scores were recorded. Quality grade, yield grade and fat thickness at the 12th rib were recorded following a 48 hr. chill. Final weights were calculated as hot carcass weight divided by a common dressing percentage (62).

Results

In Trial 1, steers fed the balanced ration had lower ($P < .01$) DMI than steers fed the control ration (Table 2). Gains and feed efficiency of steers fed the balanced ration were similar to control steers, despite feeding a diet that was 2% units lower in crude protein and contained no supplemental P. Carcass traits were also unaffected by dietary treatment.

In Trial 2, calves fed the balanced ration had similar DMI, ADG and feed efficiency as control animals. Initially, calves on the balanced ration were fed

more escape protein (UIP) and gains were numerically greater than control steers. Dry matter intake did vary between treatments during each finishing phase.

Results indicate the 1996 NRC requirement system is an effective tool to manipulate protein feeding regimens in the feedlot without compromising animal performance. Additionally, “phase feeding” matches dietary supply with changes in animal nutrient requirements with time on feed. However, this system does require formulation of multiple finisher rations, increasing feed delivery management and supplement inventory.

Phosphorus is an expensive nutrient and is not as critical to supplement (1998 Beef Report, pp 78) in feedlot diets as is commonly believed, especially since energy sources are normally greater than 0.25 % P. Animal performance for both calves and yearlings was unaffected by decreasing P levels below 0.25 %. Therefore, we conclude P supplementation is unnecessary because of the monetary and potential environmental cost.

Table 2. Performance of finishing yearlings and calves.

Item	Trial I — Yearlings				Trial II — Calves			
	Control	Balanced	SE	P<	Control	Balanced	SE	P<
Initial wt.	652	660	2.8	.12	539	542	.63	.01
Final wt.	1249	1249	9.8	.99	1245	1247	10.8	.59
DM Intake	26.2	25.0	.20	.01	20.6	20.5	.25	.77
ADG	4.06	4.01	.06	.60	3.66	3.65	.06	.74
Feed/gain ^a	6.45	6.21		.15	5.72	5.64		.61
HCW ^b	774	774	6.1	.99	769	774	6.7	.59
QG ^c	18.5	18.1	.25	.30	18.5	18.3	.10	.17
Fat depth	0.52	0.51	.01	.70	0.55	0.53	.01	.14

^aAnalyzed as gain to feed, the reciprocal of feed to gain.

^bHot carcass weight.

^cQuality grade where 18 = Select+, 19 = Choice-.

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